IS 10245-1 (1996): Breathing apparatus, Part 1: Closed circuit breathing apparatus (compressed oxygen cylinder) [CHD 8: Occupational Safety, Health and Chemical Hazards]

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(पहला पुनरीक्षण)

Indian Standard

BREATHING APPARATUS

PART 1 CLOSED CIRCUIT BREATHING APPARATUS (COMPRESSED OXYGEN CYLINDER) — SPECIFICATION

(First Revision)

ICS 13.340.30

BUREAU OF INDIAN STANDARDS
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Price Group 7

Industrial Safety Sectional Committee, CHD 8

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Industrial Safety Sectional Committee had been approved by the Chemical Division Council.

This Indian Standard was first published in 1982 and the revision of this standard is required to make this standard compatible with the international standard. This standard is harmonized technically equivalent to EN 145.

Breathing apparatus enables a person to remain in irrespirable and poisonous atmosphere for a long or short period and to still retain his full physical and mental capacity. It is also known as rescue apparatus, anti-gas apparatus, respirator, smoke helmet, and gas mask. The apparatus is required in mines, gas works, chemical factories, iron works, steel plants, smelting and metallurgical works, oil refineries and oil tankers. It may also be used by fire brigade, municipality, defence personnel and mountaineers.

Breathing apparatus should be of such efficiency and reliability as to ensure safety in toxic gases, oxygen-deficient atmosphere, extreme heat, high humidity, and wreckage and falls during disaster. It is, therefore, imperative that breathing apparatus should have an appropriate design, efficiency and safety under various conditions including temperature, resistance, quality of materials, and workmanship. Besides, it should ensure chemical purity of oxygen breathed and pass rigorous physiological, physical, chemical and mechanical tests. These are prescribed in this standard which is being issued in different parts.

This part deals with closed-circuit breathing apparatus in which the exhaled air is re-breathed by the wearer after the carbon dioxide concentration has been effectively reduced and the oxygen concentration enriched. It is used either with a full face piece or with mouth piece and nose clip.

A closed -circuit breathing apparatus should not be used in pressures appreciably above atmosphere, and care should be taken in the choice of breathing apparatus itself where such equipment is to be used in very high (45 ± 3°C) or very low (– 6 ± 3°C) ambient temperatures.

Certain toxic substances which may occur in some atmosphere can be absorbed by the skin, where these do occur, respiratory protection alone is not sufficient and the whole body should be protected.

The composition of the Technical Committee and Subcommittee responsible for formulation of this Indian Standard is given in Annex G.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

BREATHING APPARATUS

PART 1 CLOSED CIRCUIT BREATHING APPARATUS (COMPRESSED OXYGEN CYLINDER) — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard prescribes requirements of design, construction and performance and laboratory and practical tests for closed-circuit types of breathing apparatus in which the exhaled air is re-breathed by the wearer after the carbon dioxide concentration has been effectively reduced and the oxygen concentration enriched. It is used either with a full facepiece or with mouthpiece and noseclip. It uses oxygen from a cylinder of compressed oxygen.

1.2 This standard excludes breathing apparatus which operate on liquid oxygen and chemically produced oxygen.

2 REFERENCES

2.1 The Indian Standards listed in Annex A contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate by dated or undated the possibility of applying the most recent editions of the standards.

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions shall apply.

3.1.1 *Working Duration*

The maximum period of time for which the apparatus should be used.

3.1.2 *Effective Duration*

The time for which the apparatus can be expected to function satisfactorily. This time will be equal to the working duration plus a reserve period of at least 10 min for the apparatus of less than 45 min working duration and 15 min for working durations between 45 and 75 min. For apparatus with a working duration of more than 75 min the reserve period shall be at least 20 percent of the working duration or 30 min, whichever is less.

3.1.3 *Inhaled Air*

The atmosphere breathed in by the wearer.

3.1.4 *Exhaled Air*

The atmosphere breathed out by the wearer.

4 REQUIREMENTS

4.1 Construction

4.1.1 *Method of Operation*

Closed-circuit breathing apparatus is designed and constructed so that exhaled air passes from a facepiece or mouthpiece through a breathing tube into a purifier containing chemicals which absorb the exhaled carbon dioxide. Oxygen is fed into the breathing circuit from a cylinder of compressed oxygen. The oxygen and purified gases mix and are fed to the wearer who inhales from a breathing bag, and any excess gas is released through a relief valve. Typical schematic circuit diagrams are illustrated in Fig. 1.

4.1.2 *Materials*

4.1.2.1 All materials used in the construction shall have adequate mechanical strength, durability and resistance in deteriortion by heat or by contact with sea water/mine water. Such materials shall be antistatic and fire resistant as far as is practicable.

Exposed parts of the apparatus, excluding cylinders, that is those which may be subjected to impact during use, shall not be made of magnesium, titanium, aluminium or alloys containing such proportions of these metals as will, on impact, give rise to frictional sparks capable of igniting flammable gas mixtures.

Any cylinder making use of such materials shall be adequately protected so that, when tested according to national regulations for impact and scraping, no metal shall be exposed.

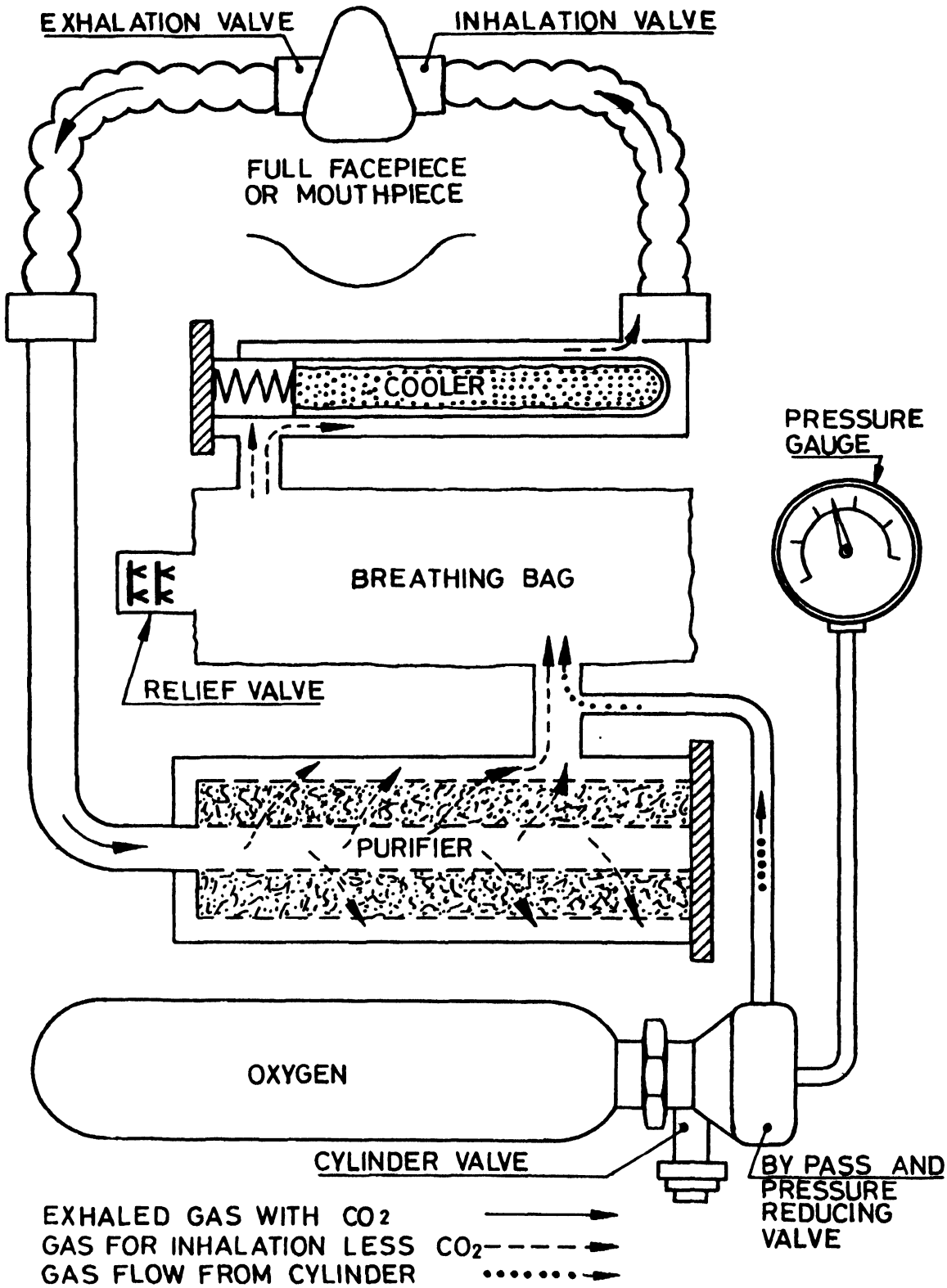

FIG. 1 SELF-CONTAINED BREATHING APPARATUS, CLOSED-CIRCUIT COMPRESSED OXYGEN TYPE (TYPICAL SCHEMATIC DIAGRAM)

NOTE — It is important that care is taken in selecting material that may come into contact with high pressure oxygen.

4.1.2.2 Materials that may come into contact with the skin shall be non-staining, soft, pliable and shall not contain known dermatitic substances.

4.1.3 *Strength and Resistance in Water*

The apparatus shall be sufficiently robust to withstand the rough usage it is likely to receive in service and designed so that it will not be rendered defective if temporarily submerged in water. If the apparatus is submerged in water some deflation of the breathing bag will occur due to the automatic operation of the relief valve.

4.1.4 *Separation of Parts*

The design and construction of the apparatus shall permit its component parts to be readily separated for cleaning, examination and testing. The couplings required to achieve this shall be readily connected and secured, where possible by hand. Any means for sealing used shall be retained in position when the joints and couplings are disconnected during normal maintenance.

4.1.5 *Adjustable Parts*

All parts requiring manipulation by the wearer shall be readily accessible and easily distinguishable from one another by touch. All adjustable parts and controls shall be so constructed that their adjustment is not liable to accidental alteration during use.

4.1.6 *Mass*

The mass of the breathing apparatus, fully charged and ready for use shall not exceed 16.0 kg (including breathing fittings).

4.1.7 *Leak Tightness*

The apparatus shall be so designed and constructed as to prevent ingress of the eternal atmosphere within the limits set out in this standard. The assembled apparatus shall be designed and constructed so that it can be tested for leak tightness by complete immersion in water or suitable testing device.

4.1.8 *Cleaning and Decontamination*

The design of the apparatus shall be such as to facilitate cleaning. All exposed surfaces shall be able to withstand treatment by one of the methods described in Annex B with appreciable deterioration.

4.2 Facepiece

Facepieces are not suitable for persons with beards. Unless special fabrications are made, they will also not be suitable for wearers with spectacles, having side arms. In such situations, mouthpiece with nose clips should be preferred.

Where facepieces are used, they shall be designed to meet the following requirements.

4.2.1 The component parts, including breathing tubes, shall withstand a test under water at an air pressure of 1.7 kN/m and shall be proved from leakage.

4.2.2 Facepiece shall cover the eyes, nose, mouth and chin and shall provide adequate sealing on the face of the wearer of the breathing apparatus against the outside gas, when the skin is dry or moist, when the head is moved and when the wearer is speaking.

4.2.3 Facepiece shall fit against the contours of the face so that, when tested in accordance with Annex C, the inward leakage of the test contaminant between the facepiece and the wearer's face shall not exceed a value of 0.05 percent the inhaled air for any one of the ten test subjects. It is unlikely that this requirement will be met by wearers with beards or with spectacles having side arms.

4.2.4 Facepieces shall be light in mass and comfortable to wear for long periods. The mass shall be systematically balanced to ensure the maximum retention of faceseal and to minimize muscular strain, particularly when worn in circumstances involving vigorous movements.

4.2.5 Facepieces shall have suitable and, preferably, replaceable eye-pieces or eyeshields. Eyepieces or eyeshields shall be made of non-splinterable, clear and non-inflammable material.

4.2.6 Facepieces shall be secured to the face by means of an adjustable and replaceable head harness and they shall be fitted with a strap to support them when not being worn.

4.2.7 Means for speech transmission shall be incorporated.

4.2.8 The manufacturer shall provide means to reduce misting of the eyepieces or eyeshields in order that vision is not interfered with when the apparatus is tested in accordance with Annex D.

4.2.8.1 The dead space in the facepiece shall be as low as possible.

4.2.8.2 The facepiece shall give wide field of vision.

4.2.8.3 Where manual wipers are provided in the facepiece, they shall be effective, durable, easy to operate and should not bit the eyebrow of the wearer.

4.3 Head Harness

4.3.1 The head harness shall hold the facepiece or mouthpiece firmly and comfortably in position. It shall be simply fitted and adjusted, and shall be capable of ready cleaning and decontamination. Any fabric used in the construction of a head harness shall be resistant to shrinkage and shall not cause any irritation to the skin of the wearer.

4.3.2 The head harness shall be adjustable and, if consisting only of straps, these shall be adjustable and not less than 19 mm (nominal) width at the points in contact with the head, and designed so as to ensure that the wearer must read just the straps before each occasion of use.

4.3.3 The head harness strap shall be slip-proof and durable.

4.4 Mouthpiece

If the apparatus is fitted with a mouthpiece it shall be designed to provide a reliable seal with the mouth and shall be secured against accidental displacement by means of an adjustable head harness. It is recommended that a plug or cover be provided to close the orifice of the mouthpiece when not in use. It shall not be possible to close the orifice of the mouthpiece by pressure.

NOTE — If gastight eye protectors are required, those complying with the requirements of IS 5983 : 1980, are recommended.

4.5 Nose Clip

A nose clip shall be provided if a mouthpiece is used and should be designed to afford maximum security against accidental displacement; it should not slip when the nose becomes moist with perspiration, and suitable means shall be provided for attaching it to the apparatus to prevent loss. The nose clip shall be so designed as to afford reasonable comfort to the wearer throughout the effective use of the apparatus.

4.6 Body Harness

The body harness shall be designed to allow the user to don the apparatus quickly and easily without assistance and shall be adjustable for fit. Buckles fitted to waist and shoulder harness shall be so constructed that once adjusted they will not slip.

Any fabric used in the construction of a body harness shall be resistant to shrinkage. For certain applications the body harness shall be detachable to permit water immersion testing, or the component parts shall not retain water. Where the body harness incorporates means for attachment of a life line, the harness, together with the snap hook, shall be capable of withstanding a drop test of 1 m when loaded to 75 kg.

4.7 Inhalation and Exhalation Valves

4.7.1 The design of valve assemblies shall be such that valve discs or the assemblies can be readily replaced; it shall not be possible to fit an inhalation valve assembly in the expiratory circuit or an exhalation valve assembly in the inspiratory circuit or to fit a valve assembly in the reverse manner.

4.7.2 The inhalation and exhalation valves shall be protected against external influence. The design and construction of exhalation valves shall be such as to prevent inward leakage of contaminated air. Any non-return valve (inhalation or exhalation), controlled by the breathing action of the wearer, shall have minimum slip. The materials used in the construction of valves should be such that the efficiency of the valve shall not be impaired by any heat or moisture likely to be encountered in use.

4.7.3 The disc valves shall offer least resistance in operation.

4.8 Relief Valve

4.8.1 *General*

Breathing apparatus of the closed-circuit type shall be provided with a relief valve operated automatically by the pressure in the breathing circuit and designed so that inward leakage of the external atmosphere shall not exceed 0.002 5 percent when the moist valve is tested in accordance with Annex F. The relief valve, which shall include an additional non-return valve, shall be protected against dirt and mechanical damage. Means shall be provided for sealing the relief valve to permit leak testing.

4.8.1.1 Breathing apparatus fitted with a manual relief valve shall also be permissible.

4.8.2 *Performance Characteristics of Relief Valve*

4.8.2.1 The opening pressure of the moist relief valve

measured at a constant flow of 1 l/min shall be between 15 mm H_2O and 40 mm H_2O in any position of the valve.

NOTE — 1 mm H_2O = 10 N/m^2

4.8.2.2 If the relief valve is positioned in the breathing circuit before the regeneration cartridge then the pressure between the relief valve and the entry of the breathing bag shall be in no case greater than the minimum opening pressure of the relief valve. The resistance of the relief valve shall not exceed 50 mm H_2O in any orientation of the valve when tested:

a) at 50 l/m for sets with a continuous flow rate greater than 2 l/m, and

b) at 30 l/m for sets with a continuous oxygen flow rate less than 2 l/m.

4.8.2.3 In apparatus using compressed oxygen, the resistance of the relief valve to an air flow of 50 l/min shall not exceed 50 mm H_2O in any position of the valve.

4.9 Reducing Valve or Pressure Reducer

4.9.1 In apparatus using a reducing valve or pressure reducer alone that is, without a supplementary lung-governed oxygen supply (*see* 4.10), the flow of oxygen shall be not less than 4 l/min for the effective duration of the apparatus except that for apparatus with a pressure reducer the oxygen flow during the reserve period may fall to not less than 1.8 l/min.

4.9.2 The flow of oxygen from a reducing valve of constant flow type shall remain constant to within 10 percent of the preset flow at all cylinder pressures above ten atmospheres.

4.9.3 The reducing valve, if adjustable, shall be provided with a suitable locking device to prevent accidental alteration of the oxygen supply.

4.10 Lung-Governed Oxygen Supply (Demand Valve)

4.10.1 The opening pressure of the lung-governed supply mechanism measured at a constant flow of 10 l/min, shall not exceed 35 mm H_2O.

4.10.2 Apparatus operating with a lung-governed supply alone or with constant supply of less than 2 l/min shall have an automatic scavenging device by means of which sufficient 'air' is removed from the circuit to the outside to maintain an oxygen content of not less than 21 percent.

4.10.3 The lung governed oxygen supply valve shall function so as to provide oxygen in accordance with the breathing requirements of the wearer of the apparatus and be capable of passing sufficient oxygen to replace the oxygen consumed when he is breathing at the rate of 50-90 l/min with any cylinder pressure above 1 000 kN/m^2.

4.11 By-Pass Valve

4.11.1 Apparatus equipped with a pressure reducer or a reducing valve and/or lung/governed valve, shall be provided with a manually operated by-pass valve of self-closing type, whereby the wearer can obtain a supply of oxygen at a flow of between 50 l/min and 90 l/min at all cylinder pressures above 5 000 kN/m^2 independently of the reducing valve or lung-governed valve.

4.11.2 The shape and size of the valve control shall be such that it can be operated even with a wet or slippery hand.

4.12 Pressure Gauge

4.12.1 Apparatus using compressed oxygen shall have a pressure gauge which shall incorporate a suitable blow-out release so that in event of an explosion or fracture of the pressure element of the gauge, the blast will be away from the front. The gauge shall have a window of non-splintering glass or of clear plastic material.

4.12.2 An efficient valve shall be provided to isolate the gauge and connections to it from the rest of the circuit.

4.12.3 The pressure gauge shall be placed to enable the gas cylinder pressure to be read conveniently by the wearer.

4.12.4 The pressure gauge shall incorporate a means of indicating an adequate warning period and shall be shown in red colour.

4.12.5 The pressure gauge (*see* IS 3624 : 1987 and IS 8457 : 1977) shall withstand pressure greater than the maximum cylinder pressure so that it will operate continuously and accurately without overstrain. Pressure gauge for use with such apparatus shall be shock-resistant.

4.13 Warning Device

4.13.1 The apparatus shall be so designed that the wearer is warned immediately if the main valve is closed or if the cylinder fitted is empty.

If this warning device is controlled by the oxygen pressure, an immediate warning shall be given to the wearer when any leakage in excess of 0.4 l/min occurs in the parts of the warning device containing oxygen. The loss of oxygen from one warning system shall not exceed 0.6 l/m at full cylinder pressure.

As an option, an indication of low cylinder pressure is permitted.

4.14 Flexible Tubes

Flexible tubes and fittings of the high pressure system shall be capable of withstanding without damage a best pressure of twice the maximum designed working pressure. It shall not be possible to fit in low pressure part or those into a higher pressure part of the circuit.

4.15 Gas Cylinder and Main Valve

4.15.1 Gas cylinders and the valves fitted thereto shall comply with the provisions of *Gas Cylinder Rules*, 1981, as amended from time to time.

4.15.2 Cylinders shall be coloured in accordance with IS 3933 : 1966.

4.15.3 The main valve shall comply with the requirements of IS 7302 : 1974 and shall be so designed that the full pressure in the gas cylinder cannot be applied rapidly to other parts of the apparatus.

4.15.4 The valve shall be so designed that the valve spindle cannot be completely unscrewed from the assembly during normal operation of the valve.

4.15.5 The valve shall be either lockable in the open position or designed so that it cannot be closed inadvertently by contact with a surface.

4.15.6 The main valve should be easily accessible and distinguished by touch.

4.16 Oxygen Supply

The total volume of oxygen available shall be sufficient to meet an average consumption of not less than 4 l/min for breathing apparatus without lung-governed demand valve and 1.5 l/min for that with lung-governed demand valve. In apparatus without a supplementary lung-governed oxygen supply an additional 10 percent capacity shall be provided to allow for the possible use of the by-pass valve.

4.17 Breathing Bag

4.17.1 The breathing bag shall be made of strong, flexible material and shall be protected against collapse of damage by external agencies. It shall be made from anti-static material.

4.17.2 The breathing bag shall be reliably and tightly joined to the couplings. The coupling at the inhalation side shall be shaped in such a way that its opening cannot be closed by the bag itself.

4.17.3 In apparatus using compressed oxygen, the capacity of the breathing bag, when correctly fitted and with the casing closed, shall be at least 5 litres.

4.17.3.1 In apparatus using compressed oxygen without a lung-governed supply, the capacity of the breathing bag is measured between the opening pressure of the relief valve (*see* **4.8.2.1**) and minus 20 mm H_2O relative to atmospheric pressure.

4.17.3.2 In compressed oxygen type apparatus with a lung-governed oxygen supply, the capacity of the breathing bag is measured between the opening pressure of the relief valve (*see* **4.8.2.1**) and the opening pressure of the lung-governed supply (*see* **4.10.1**), relative to atmosphere pressure.

4.17.4 In apparatus using liquid air, the capacity of the breathing bag, when correctly fitted and with the casing closed shall be measured between the opening pressure of the relieve valve (*see* **4.8.2.1**) and minus 20 mm H_2O relative to atmospheric pressure, and shall be:

a) at least 4.5 litres when the liquid evaporates at a rate of 8 l/min or more at STP, and

b) at least 5.0 litres when the evaporation rate is less than 8 l/min at STP.

The evaporation rate is measured at the end of the working duration, when the apparatus if tested in accordance with Annex E.

4.17.5 The number of connections of breathing bag with the breathing circuit should be minimum for proper maintenance of the breathing bag.

4.18 Breathing Tubes

4.18.1 Breathing tubes shall be flexible and non-kinking and of sufficient length to permit free head movement of the wearer. They shall be made from anti-static material.

4.18.2 The breathing tubes shall, preferably, have a type of connection which enables either a mouthpiece with nose clip or a facepiece to be fitted.

4.18.3 The design of the breathing tubes shall be such as to offer least breathing resistance.

4.18.4 The construction of the breathing tubes shall be such that in normal use, they shall not flatten to impede the flow of gas.

4.18.5 The dead space of the breathing tube should be as low as possible.

4.18.6 For breathing apparatus carried at the back of the wearer, when underarm, deep corrugated tubes are used, a loop supporting the breathing tubes shall be of a type and so fixed that it shall not damage the tubes during use.

4.19 Condition of the Inhaled Air

4.19.1 *Oxygen Content*

When tested in accordance with Annex D, the oxygen content of the inhaled air shall not fall below 21 percent (by volume).

4.19.2 *Carbon Dioxide Content*

4.19.2.1 When apparatus using a mouthpiece and facepiece is tested in accordance with Annexes D and E, the carbon dioxide content of the inhaled air (including dead space effects) shall not exceed an average of 1.25 percent (by volume) and shall at no time exceed 1.5 percent (by volume) during the working duration of the apparatus.

4.20 Temperature and Humidity

4.20.1 Particular care shall be taken in the choice of a closed circuit breathing apparatus when it is intended to use it in:

a) very high temperatures, for example 45°C; and

b) ambient temperatures of –6 ± 3°C.

4.20.2 The temperature of the inhaled air independence of humidity shall not exceed 45°C.

4.21 Breathing Resistance

Maximum breathing resistance

Minute Volume	*Breathing Resistance*	
	Inhalation mbar	Exhalation mbar
10 resp/min × 1.0 l/resp	1.0	3.0
20 resp/min × 1.5 l/resp	3.0	3.0
25 resp/min × 2.0 l/resp	5.0	7.0
30 resp/min × 2.5 l/resp	10.0	10.0

During the machine test at 100 l/min (40 × 2.5), the apparatus shall function satisfactorily.

4.22 Comfort

When tested in accordance with Annex D the apparatus shall be such that it is worn without avoidable discomfort, that the wearers show no undue signs of strain attributable to wearing the apparatus, and that it impedes the wearers as little as possible when in a crouched position or when working in a confined space.

4.23 Purity of Oxygen

In all closed. circuit breathing apparatus, the purity of oxygen to be used shall be not less than 99 percent.

4.24 Preflushing Device

Apparatus operating with a lung governed supply alone or mixed type with a constant flow of less than 1.5 l/min shall be equipped with a device which at the beginning of breathing or at opening of the main valve automatically feeds 5 to 10 l of oxygen into the breathing circuit.

4.25 Saliva Trap

4.25.1 A saliva trap to accumulate saliva of the wearer, if provided, shall be fixed with the inhalation tube.

4.25.2 The saliva trap nut shall be so fixed that it shall not get lost during cleaning and decontamination.

4.26 Protective Casing

4.26.1 If possible, the whole breathing apparatus shall be covered by a protective casing to protect the breathing bag, regulator, reducing valve and other vital parts of the apparatus against direct blows and falling materials.

4.26.2 It shall be made of light metal of adequate strength or of tough moulded fibre glass. It shall be so designed that it permits ease of passage through narrow spaces.

5 INSTRUCTIONS

5.1 Breathing apparatus manufactured in compliance with this standard shall be supplied/accompanied by operating instructions for maintenace and use which shall include, where appropriate:

a) nominal working duration;

b) guidance on fit of facepiece, and adjustment of faceseal where relevant;

c) a warning that adequate protection may not be provided by the apparatus in certain highly toxic atmospheres and the guidance should be sought from IS 9623:1980;

d) a warning that allowance should be made for the fact that it is likely that faceseal fit may not be suitable for persons wearing spectacles, or having sideburns or beards; and

e) grain size of carbon dioxide absorbent (*see* IS 5321:1969).

6 MARKING

6.0 Breathing apparatus manufactured in compliance with this standard shall be marked with the following particulars.

6.1 Marking on the Facepiece

The facepiece shall be marked with the following:

a) Name, trade-mark or other means of identification of the manufacturer;

b) Size (if more than one size is available); and

c) Year and month of manufacture.

6.2 Marking on the Apparatus

The apparatus shall be marked with the following:

a) Name, trade-mark or other means of identification of the manufacturer;

b) Class 1 or 2 as appropriate (*see* **4.20**);

c) Working duration:

1) With warning device,

2) Without warning device, and

d) Year and month of manufacture shall be marked legibly on breathing bags, breathing tubes, mouthpiece, facepiece and diaphragm.

ANNEX A

(*Clause* 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
3624:1987	Pressure and vacuum gauges (*second revision*)	8457:1977	Type pressure gauges or automobiles (pocket type)
3933:1966	Colour identification of gas cylinders and related equipment intended for medical use	8522:1977	Respirators, chemical cartridge
5321:1969	Soda lime (as carbon dioxide absorbent)	8523:1977	Respirators, canister type (gas masks)
5983:1980	Eye protectors (*first revision*)	9623:1980	Recommendations for selection, use and maintenance of respiratory protective devices
7302:1974	Valve fittings for gas cylinder valves for use with breathing apparatus		

ANNEX B

(*Clause* 4.1.8)

TEST FOR DURABILITY OF MATERIALS WHEN SUBJECTED TO CLEANING AND DECONTAMINATION

B-1 PROCEDURE

B-1.1 Components to be tested are:

a) Immersed for 10 min in a solution of formalin made by placing one part of 40 percent formaldehyde solution in nine parts of water at a temperature of 20°C; or

b) Subjected to a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 min at a temperature of 20°C.

ANNEX C

(*Clause* 4.2.3)

TEST FOR INWARD LEAKAGE OF FACEPIECE

C-1 TEST SUBJECTS

C-1.1 Ten clean shaven persons are selected, covering a broad spectrum of facial characteristics (excluding significant abnormalities). It is to be expected that, exceptionally, some persons cannot be satisfactorily fitted with a full facepiece; such exceptional subjects are not used for testing facepieces.

C-2 FACEPIECES

C-2.1 If more than one size of facepiece is manufactured, the test subjects are supplied with the appropriate size.

C-3 TEST PROCEDURE

C-3.1 Each test subject wearing the facepiece under test complete with breathing tubes, is enclosed in a plastic hood which is loosely tied around his waist and around the breathing tubes so that leakage is minimized. The inside of the hood is maintained at a pressure not more than 3 mm H_2O above atmosphere by supplying pure argon to the interior of the hood. (By preliminary inflation of the hood with argon and then by adjusting the argon supply when the hood has been fitted, the atmosphere surrounding the facepiece is maintained at the concentration obtained from the argon cylinder).

C-3.1.1 Each subject walks on a treadmill at 6.5 km/h whilst separately carrying out various head movements and reciting the alphabet.

C-3.1.2 The subject inhales through a breathing tube from a lung-governed oxygen supply and exhales through a breathing tube and a sampling bladder to the atmosphere. The amount of argon in the expired gas is determined, for example, by using a mass spectrometer, and compared with the argon present within the hood obtain the facepiece leakage.

ANNEX D

(*Clauses* 4 2 8, 4 19 1, 4 19 2 1 *and* 4 22)

PRACTICAL PERFORMANCE TEST

D-1 TEST SUBJECTS

D-1.1 Breathing apparatus is tested by test subjects who practise regularly with breathing apparatus and whose medical history is known to be satisfactory They shall be medically examined immediately before the tests and certified fit to undertake the test procedures Each subject is suitably clothed

D-2 MEDICAL ATTENTION

D-2.1 The tests shall be carried out under the supervision of a registered medical practitioner

D-3 PREPARATION OF APPARATUS TO BE TESTED

D-3.1 In apparatus using compressed oxygen, the high pressure cylinders are purged with oxygen before being charged A sample of the compressed oxygen is analysed for oxygen content and the flow of oxygen into the apparatus is measured. After the purifier is charged and the apparatus assembled, the resistance to breathing is measured The apparatus, with the cylinder charged to the prescribed pressure and ready for use, is then tested for leak tightness

D-3.2 In apparatus using liquid air, the purifier is charged, the apparatus assembled and the resistance to breathing is measured The apparatus is tested for leak tightness, then charged with liquid air.

D-4 TEST PROCEDURES

D-4.1 Two kinds of test are made, one in which two subjects wearing the apparatus walk at a regular rate of 6 5 km/h on a level course (walking test), and one in which two different subjects work in practical conditions (work simulation test). Each test is continuous, without removal of the apparatus, for a period equal to the working duration of the apparatus, except that rest periods of 5 min are taken after each 15 min period of usage.

D-4.1.1 The work simulation tests shall comprise

a) Carrying sand bags over a distance of at least 9 m and building of the top section of a 1 4 m high stopping;

b) Negotiating a circuit of the gallery which comprises

1) Steps and a ramp,

2) A restricted height carrying from 1 2 m to 1 0 m,

3) A restricted height varying from 0 4 to 1 0 m, and

4) An opening 0 6 m high × 0 9 m wide and 3 7 m long

c) Carrying, pushing or pulling on a stretcher a dummy body weighing 68 kg around the same circuit of the gallery,

d) Passing sandbags through a steel tube 3 7 m long × 0 7 m in diameter,

e) Repeated raising the lowering of a weight of 25 4 kg to and from a height of 1 8 m by means of a rope and pulley,

f) Climbing over three 1 2 m high hurdles,

g) Climbing up and down a vertical ladder with a 460 mm square opening around the ladder, and

h) Carrying and building chock (wooden slipper) pieces in still air in a climatic chamber where the temperatures measured by hygrometer are

1) Dry bulb 45 ± 3°C, and

2) Wet bulb 3 - 5°C lower than the dry bulb

D-4.2 During the test periods and at the end of each test, the inhaled air is sampled and tested, the temperature, cylinder pressures and ambient temperatures are recorded, and the medical practitioner asks such clinical observations considered necessary by him. When a facepiece is worn the test includes a period of speech by each subject and the inward faces leakage is checked subjectively using a suitable vapour of characteristic smell At the end of each test the subjects are medically examined, and the apparatus is examined for leak tightness, oxygen/air flow, resistance to breathing, excessive wear of parts and physical damage

ANNEX E

(*Clauses* 4 17.4 *and* 4 19 2 1)

LABORATORY PERFORMANCE TEST

E-1 GENERAL

E-1.1 This test should be carried out by a lung simulator machine designed to provide sinusoidal air flows and operating at a rate corresponding to 20 respirators per minute

E-2 LUNG SIMULATOR MACHINE

E-2.1 The machine delivers to the complete apparatus under test a tidal volume of 2 litres of a 5 percent (by volume) carbon dioxide/air mixture fully saturated at a temperature of 37°C, the total delivery being at a flow of 40 l/min The test is run continuously for a period equal to the effective duration of the apparatus with the apparatus in an environment with a relative humidity of 85-90 percent and temperature of 45°C

E-2.2 In a separate test the sinusoidal air flow is increased to 100 l/min for a period sufficient for an assessment to be made of the functioning of the breathing apparatus at this flow

E-2.3 In the case of apparatus in which the material used for absorbing carbon dioxide is contained in a canister or cartridge, the laboratory test is made on the apparatus after the purifier has been subjected for 3 min to simulated rough usage as follows

E-2.3.1 The canisters or cartridges are placed in a tray and arranged so that each has a movement of 6 mm The tray is then subjected to a horizontal reciprocating motion at a rate between 185 and 190 cycles per minute with a stroke amplitude of 83 mm

E-3 TEST FOR CANISTER OR CARTRIDGE

E-3.1 These shall be carried out as prescribed in IS 8522 1977 and IS 8523 1977

ANNEX F

(*Clause* 4 8 1)

TEST FOR INWARD LEAKAGE ON RELIEF VALVE

F-1 TEST EQUIPMENT

F-1.1 A leak tight box connected by a tube to a breathing simulator A flow of test gas is maintained through the box An instrument capable of measuring the concentration of the test gas The breathing simulator is as specified in Annex E, operating at a flow of 40 l/min with a back pressure of 50 mm H_2O

F-2 TEST PROCEDURE

F-2.1 The valve under test is fitted in the box with a suitable adaptor On the expiration stroke the valve opens and air passes into the box containing the test gas On the inspiration stroke the valve closes and any slip or leakage of the valve allows test gas to pass into the inspiratory air stream This air is monitored for test gas concentration, the difference in concentration at this point and at a suitable reference point allows the slip and leakage at this point and at a suitable reference point allows the slip and leakage of the valve to be calculated The test is run for a sufficient time to obtain a steady reading of the test gas concentration in the inspiratory air stream

ANNEX G

(*Foreword*)

COMMITTEE COMPOSITION

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(*Continued on page* 13)

(*Continued from page* 12)

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AMENDMENT NO. 1 SEPTEMBER 2007
TO
IS 10245 (PART 1) : 1996 BREATHING APPARATUS
PART 1 CLOSED CIRCUIT BREATHING APPARATUS (COMPRESSED OXYGEN CYLINDER) — SPECIFICATION

(First Revision)

(*Page* 1, *clause* 3) — Insert the following new clause after **3.1.4** and renumber the subsequent clauses:

'4 Classification

The Apparatus shall be classified as under:

Class of Apparatus		*Nominal Working Duration*, h	*Minute Volume*		
Without positive pressure	Positive pressure		Cycles/min	l/stroke	l/min
1 N	1 P	1	25	2 0	50 0
2 N	2 P	2	20	2 0	40 0
4 N	4 P	4	20	1 5	30 0

(*Page* 4, *clause* **4.8.2.1**) — Substitute the following for the existing text:

'The opening pressure of the moist relief valve at a constant flow of 1.0 l/min shall not exceed 10 mbar in the positive pressure sets and shall be between 1.0 mbar and 1.5 mbar in the sets without positive pressure.'

(*Page* 5, *clause* **4.8.2.2**) — Substitute the following for the existing text:

'The resistance of the relief valve shall not exceed 11 mbar in the positive pressure sets and shall not exceed 5.0 mbar in the sets without positive pressure when tested:

a) at 50 l/min for sets with a continuous flow rate > 2 l/min.
b) at 30 l/min for sets with a continuous flow rate up to 2 l/min.'

(*Page* 5, *clause* **4.10.1**) — Substitute the following for the existing text:

'The opening pressure of the lung governed supply mechanism measured at a constant flow of 10 l/min shall not be negative in the positive pressure apparatus and shall not exceed 3.5 mbar in the apparatus without positive pressure.'

(*Page* 7, *clause* **4.21**) — Substitute the following for the existing text and table:

Minute Volume, l/min	*Test time* min	*Measure of Breathing Resistance*	
		Without positive pressure apparatus (mbar)	Positive pressure apparatu (mbar)
50 (25 cycles/min, 2.0 l/stroke)	60	-5 to 7	0 to 7
75 (30 cycles/min, 2 5 l/stroke)	5	-10 to 10	0 to 10

During the machine test at 100 l/min (40 cycles/min × 2.5 l/stroke) the apparatus shall function satisfactorily.

[*Page* 8, *clause* **6.2**(b)] — Substitute the following for the existing:

'Class as appropriate (*see* **4**) and for temperature/humidity (*see* **4.20**)'

(CHD 8)

Reprography Unit, BIS, New Delhi, India